What is claimed is:

1. An optical circuit comprising: a silicon substrate; an optical waveguide layer formed on the silicon substrate, the optical waveguide layer having a core and a cladding; and temperature control means formed on the optical waveguide layer, for variably controlling the temperature of a portion of the core locally; wherein the optical waveguide layer on both sides sandwiching a portion on which the temperature control means is formed is removed from a region spaced from the core along a longitudinal direction of the core, from a surface of the optical waveguide layer to a surface of the silicon substrate; a recessed portion having a rectangular cross-sectional shape is provided in a surface portion of the silicon substrate including an entire region facing a bottom part of the optical waveguide layer-removed portion; the surface of the silicon substrate is formed of a silicon (100) crystal plane, a side face of the recessed portion formed along the longitudinal direction of the core is formed of a silicon (100) crystal plane substantially perpendicular to the silicon substrate surface, and a bottom face of the recessed portion is formed of a silicon (100) crystal plane substantially parallel to the silicon substrate surface.

14 ~~2.~~ An optical circuit comprising: a silicon substrate; an optical waveguide layer formed on the silicon substrate, the optical waveguide layer having a core and a cladding; and temperature control means formed on the optical waveguide layer, for variably controlling the temperature of a portion of the core locally; wherein the optical waveguide layer on both sides sandwiching a portion on which the

temperature control means is formed is removed from a region spaced from the core along a longitudinal direction of the core, from a surface of the optical waveguide layer to a surface of the silicon substrate; a recessed portion having a rectangular cross-sectional shape is provided in a surface portion of the silicon substrate including an entire region facing a bottom part of the optical waveguide layer-removed portion; the surface of the silicon substrate is formed of a silicon (111) crystal plane, a side face of the recessed portion formed along the longitudinal direction of the core is formed of a silicon (110) crystal plane substantially perpendicular to the silicon substrate surface, and a bottom face of the recessed portion is formed of a silicon (111) crystal plane substantially parallel to the silicon substrate surface.

2 ~~3.~~ The optical circuit according to claim 1, wherein the recessed portion of the silicon substrate is formed by anisotropic etching of silicon using an alkaline solution.

15 ~~4.~~ The optical circuit according to claim ~~2,~~ 14 wherein the recessed portion of the silicon substrate is formed by anisotropic dry etching of silicon and anisotropic etching of silicon using an alkaline solution that is successively performed after the anisotropic dry etching.

3 ~~5.~~ The optical circuit according to claim 1, wherein the temperature control means is a thin film heater.

4 ~~6.~~ The optical circuit according to claim 1, wherein the optical waveguide layer is formed of quartz-based glass.

5 ~~7.~~ An optical circuit device comprising:

an optical circuit according to claim 1, the core of the optical circuit having a coupler-forming core that forms at least two optical splitter/couplers for performing at least one of splitting and coupling of light and at least two connecting cores that connect the coupler-forming cores together, and at least one of the connecting cores having a temperature control means.

6 ~~8.~~ The optical circuit device according to claim 5 ~~7,~~ wherein the coupler-forming core is formed of two juxtaposed cores being adjacent to each other, and the connecting core has a Mach-Zehnder interferometer circuit formed of two juxtaposed cores that are spaced apart from each other.

11 ~~9.~~ The optical circuit device according to claim 5 ~~7,~~ further comprising: at least one optical input waveguide; a first slab waveguide connected to an output side of the optical input waveguide; an arrayed waveguide connected the output side of the first slab waveguide and composed of a plurality of juxtaposed channel waveguides having lengths being different from one another by predetermined amounts; a second slab waveguide connected to an output side of the arrayed waveguide; and at least one optical output waveguide connected to the output side of the second slab waveguide, and wherein: the optical input waveguide, the first slab waveguide, and an end portion of the arrayed waveguide near the first slab waveguide side

constitute a first coupler-forming core that forms a first optical splitter/coupler; an end portion of the arrayed waveguide near the second slab waveguide side, the second slab waveguide, and the optical output waveguide constitute second coupler-forming core that forms a second optical splitter/coupler; the arrayed waveguide between the second coupler-forming core and the first coupler-forming core consititutes a connecting core.

7 ~~10.~~ An optical circuit device comprising at least one optical circuit device according to claim ~~8,~~ 6 and including a variable optical attenuation control section for varying an intensity of at least one predetermined wavelength light by controlling a temperature of the temperature control means, so that the optical circuit device is configured to be a variable optical attenuator.

8 ~~11.~~ An optical circuit device comprising at least one optical circuit device according to claim ~~8,~~ 6 and including an optical switch control section for varying an output section of at least one predetermined wavelength light by controlling a temperature of the temperature control means, so that the optical circuit device is configured to be an optical switch.

9 ~~12.~~ An optical circuit device comprising at least one optical circuit device according to claim ~~8,~~ 6 and including a variable wavelength control section for varying a wavelength of at least one of multiplexed wavelength and demultiplexed wavelength by controlling a temperature of the temperature control means, so that the optical circuit device is configured to be a variable wavelength

multiplexer/demultiplexer.

10 ~~13.~~ An optical circuit device comprising at least one optical circuit device according to claim ~~8,~~ 6 and including a variable dispersion control section for varying a dispersion value of at least one predetermined wavelength light by controlling a temperature of the temperature control means, so that the optical circuit device is configured to be a variable optical dispersion compensator for reducing a wavelength dispersion of a device to be connected.

12 ~~14.~~ A method for manufacturing an optical circuit according to claim 1, comprising, after forming a portion from which the optical waveguide layer is removed, subjecting the silicon substrate to anisotropic etching of silicon using an alkaline solution to form a recessed portion at a location of the silicon substrate surface corresponding to the portion from which the optical waveguide layer is removed.

16 ~~15.~~ A method for manufacturing an optical circuit according to claim ~~2,~~ 14 comprising, after forming portions from which the optical waveguide layer is removed, subjecting the silicon substrate to anisotropic dry etching of silicon, and thereafter subjecting the silicon substrate to anisotropic etching using an alkaline solution, to form a recessed portion at a location of the silicon substrate surface corresponding to the portions from which the optical waveguide layer is removed.

13 ~~16.~~ The method for manufacturing an optical circuit according to claim ~~14,~~ 12

wherein the alkaline solution is an aqueous solution of potassium hydroxide.

17. An optical circuit device comprising: a substrate; and an optical waveguide layer having a core and a cladding formed on the substrate, an optical waveguide circuit of the core having: an optical splitter for splitting light, an optical coupler for coupling light, a first connecting optical waveguide and a second connecting optical waveguide for connecting the optical splitter and the optical coupler, and the first and second connecting optical waveguides respectively having first and second phase adjustment means capable of varying the phases of a propagating light, the optical circuit device being formed such that the rate of change of the polarization difference of phases in the first phase adjustment means and the rate of change of the polarization difference of phases in the second phase adjustment means are different from each other with respect to a phase adjustment amount when the first and second phase adjustment means perform phase adjustment.

34 ~~18~~. An optical circuit device comprising: a substrate; and an optical waveguide layer having a core and a cladding formed on the substrate, an optical waveguide circuit of the core having: an optical splitter for splitting light, an optical coupler for coupling light, a first connecting optical waveguide and a second connecting optical waveguide for connecting the optical splitter and the optical coupler, and the first and second connecting optical waveguides respectively having first and second phase adjustment means capable of varying the phase of a propagating light, the optical circuit device being formed such that the rate of change of a birefringence of the first connecting optical waveguide and the rate of change of a birefringence of

the second connecting optical waveguide are different from each other with respect to a phase adjustment amount when the first and second phase adjustment means perform phase adjustment.

18 ~~19.~~ The optical circuit device according to claim 17, wherein a birefringence of the first connecting optical waveguide and a birefringence of the second connecting optical waveguide are different from each other.

19 ~~20.~~ The optical circuit device according to claim 17, wherein at least one of first and second birefringence control means is formed in the vicinity of a portion in which the first or second phase adjustment means is formed.

20 ~~21.~~ The optical circuit device according to claim 19 ~~20,~~ wherein the first and second birefringence control means are first and second stress-releasing means for releasing stress imparted to the optical waveguide in a formation portion in which the first and second phase adjustment means are formed.

21 ~~22.~~ The optical circuit device according to claim 20 ~~21,~~ wherein the first and second stress-releasing means are formed so that: the optical waveguide layer on both sides sandwiching at least one of portions on which the first and second phase adjustment means are formed is removed from a region spaced apart from the connecting optical waveguide along the longitudinal direction of the connecting optical waveguide, from a surface of the optical waveguide layer to a surface of the substrate, so as to form an optical waveguide layer-removed portion; and the width

of a first optical waveguide layer and the width of a second optical waveguide layer are different from each other, the first and second optical waveguide layers including the first and second connecting optical waveguides juxtaposed with the optical waveguide layer-removed portion.

22 ~~23.~~ The optical circuit device according to claim ~~22,~~ 21 wherein the optical waveguide layer-removed portion is such that the optical waveguide layer is removed from the surface of the optical waveguide layer surface to the surface of the substrate.

23 ~~24.~~ The optical circuit device according to claim ~~21,~~ 20 wherein the first and second stress-releasing means are formed so that: the optical waveguide layer on both sides sandwiching at least one of portions on which the first and second phase adjustment means are formed is removed from a region spaced apart from the connecting optical waveguide along the longitudinal direction of the connecting optical waveguide, from a surface of the optical waveguide layer to a surface of the substrate, so as to form an optical waveguide layer-removed portion; a substrate-removed portion from which the substrate is removed is provided in a surface portion of the substrate facing the bottom part of the optical waveguide layer-removed portion; and the width of a first optical waveguide layer and the width of a second optical waveguide layer are different from each other, the first and second optical waveguide layers including the first and second connecting optical waveguides juxtaposed with the optical waveguide layer-removed portion.

24 ~~25~~. The optical circuit device according to claim 23 ~~24~~, wherein the substrate-removed portion is such that a substrate-removed portion being a recessed portion having a rectangular cross-sectional shape is formed in a surface portion of the substrate including an entire region facing a bottom part of the optical waveguide layer-removed portion.

25 ~~26~~. The optical circuit device according to claim 17, wherein a first dummy phase adjustment means having the same configuration as the first phase adjustment means and being placed as a dummy is formed for the second connecting optical waveguide; an optical waveguide layer-removed portion having the same configuration as an optical waveguide layer-removed portion formed by removing a region of the optical waveguide layer spaced apart from the first phase adjustment means along a longitudinal direction of the connecting optical waveguide is formed on both sides of the optical waveguide layer sandwiching a portion where the first dummy phase adjustment means is formed; the second phase adjustment means is connected spaced apart from the first dummy phase adjustment means; a second dummy phase adjustment means having the same configuration as the second phase adjustment means and serving as a dummy is formed for the first connecting optical waveguide; an optical waveguide layer-removed portion having the same configuration as an optical waveguide layer-removed portion formed by removing a region of the optical waveguide layer spaced apart from the second phase adjustment means along a longitudinal direction of the second phase adjustment means is formed on both sides of the optical waveguide layer sandwiching a portion where the second dummy phase adjustment means is formed; and the first phase

adjustment means is connected spaced apart from the second dummy phase adjustment means.

26 ~~27.~~ The optical circuit device according to claim 17, wherein the optical waveguide layer is formed of quartz-based glass.

27 ~~28.~~ The optical circuit device according to claim 17, wherein the substrate is a silicon substrate.

28 ~~29.~~ The optical circuit device according to claim 17, wherein the first and second phase adjustment means are first and second thin film heaters, respectively.

29 ~~30.~~ The optical circuit device according to claim 17, wherein first and second power supply lines for supplying power are connected respectively to the first and second thin film heaters; the first and second power supply lines are connected in parallel to a power supply; and the sum of respective resistance values of the first power supply line and the first thin film heater is equal to the sum of respective resistance values of the second power supply line and the second thin film heater.

30 ~~31.~~ The optical circuit device according to claim ~~30~~ 29, wherein a resistor is connected to at least one of the first and second power supply lines.

31 ~~32.~~ The optical circuit device according to claim 17, further comprising an optical variable attenuation control section for varying the intensity of at least one

predetermined wavelength light by adjusting phases in the phase adjustment means, so that the optical circuit device is configured to be a variable optical attenuator.

32 ~~33~~. The optical circuit device according to claim 17, further comprising an optical switch control section for varying the output of at least one predetermined wavelength light by adjusting phases in the phase adjustment means, so that the optical circuit device is configured to be an optical switch.

33 ~~34~~. A method for controlling an optical circuit device according to claim 17, comprising: adjusting the phase adjustment means so that a phase difference between the phase of TE polarized light after a propagating light propagating in the first connecting optical waveguide has propagated through the first connecting optical waveguide and the phase of TE polarized light after a propagating light propagating in the second connecting optical waveguide has propagated through the second connecting optical waveguide and a phase difference between the phase of TM polarized light after the propagating light propagating in the first connecting optical waveguide has propagated through the first connecting optical waveguide and the phase of TM polarized light after the propagating light propagating in the second connecting optical waveguide has propagated through the second connecting optical waveguide, are equal to each other.